Lens care for patient care

Nick Atkins argues that all practitioners should think carefully about their choice of lens care solution for any given lens.

It is reasonable to assume that the immediate future for many contact lens wearers – with most practitioners still reluctant to prescribe patients a continuous wear modality – is to upgrade their disposable hydrogel lenses to silicone hydrogel (SiH) materials and continue with daily lens wear and lens care.

That being the case, it is important to realise that many solutions in common use today were developed before the advent of silicone hydrogel materials and so seamless compatibility between lens and lens care system is perhaps a naive expectation. Additionally with there being so many apparently similar products and generally happy patients, it is perhaps understandable that, over the years, many practitioners have become blasé about lens care and pay little attention to the combination of lens and lens care solution they are ‘prescribing’ their patients.

Solution sensitivity is a problem found primarily in soft lens patients due to the nature of the lens material adsorbing the solution and may result from toxicity to the chemical makeup of the solutions used to disinfect and clean the lens (ie preservatives, added surfactant), a patient’s allergic reaction to the solution ingredients, using a solution inappropriately (ie inadvertently getting lens cleaner or hydrogen peroxide in the eye), or solution incompatibility with a particular contact lens material.

Objectively, the practitioner may note diffuse superficial punctuate staining, peripheral staining and/or injection (Figure 1). In a more severe reaction, corneal edema, chemosis and corneal infiltrates might be observed.

Patients may not complain of any symptoms, but at the other end of the scale symptoms can include burning, dryness, decreased wearing time, redness, vague lens discomfort or some combination of these. In addition, the patient may have increased tearing and photophobia if the reaction is moderate to severe. A patient may experience solution sensitivity as a result of an allergy to some ingredient in the solution, which can occur within minutes or after days of use of the solution. Over time, the preservative in the solution may build up in the lens matrix, increasing the concentration of the preservative and resulting in a toxic reaction to the cornea. Studies have shown that certain solution brands combined with specific silicone hydrogel lens materials are more prone to solution-related corneal staining.

This article is designed to help focus practitioners’ minds on our increasing understanding of the potential for contact lens solution interaction with modern contact lens materials and ultimately to establish the importance of a more considered approach to the choice of lens care solution.

Understanding lens/solution incompatibilities

It has long been known that even the modern polymeric preserved solutions can cause corneal staining and subjective comfort can vary depending on the formulation and concentration of polyhexanide and particularly with higher concentrations used in conjunction with high water, FDA Group II hydrogel materials. Numerous studies comparing polyhexanide with both hydrogen peroxide and polyquarternium based solutions, have shown higher levels of staining with polyhexanide.

More recently it has been found that both polyhexanide and polyquad based MPSs used with both balafilcon A (PureVision) and lotrafilcon A (Focus Night & Day) will demonstrate a varying incidence and severity of staining and that identical concentrations of polyhexanide can behave differently, depending on solution formulation. In the Jones et al study 37 per cent of PureVision wearers using ReNu MultiPlus demonstrated a solution based reaction with 11 subjects requiring discontinuation from the study.

Silicone hydrogels

Structurally, SiH contact lenses are more complex than conventional hydrogels because of the incorporation of various hydrophobic, highly oxygen-permeable components such as silicone in various forms, some fluorine species, as well as components and treatments used to improve lens wettability. With silicone hydrogel lenses, we must consider the type and size of preservative molecule as well as the interaction of ingredients, such as buffers, chelating agents, surfactants and isotonicity agents, with the bulk and surface of the lens. Neither the lens/solution interactions nor the efficacy of the lens care solution are predictable according to preservative type and concentration alone.
The role of lipid

Although not completely understood it would appear that lipids deposited on the surface of high water non-ionic hydrogel as well as low water ionic SiH lenses are a factor in the increased corneal staining sometimes observed. The binding of polyhexanide to the lipid deposits on the silicone hydrogel lens surface increases their exposure to the epithelium by acting as a kind of drug delivery system. Interestingly the staining is usually asymptomatic and appears as a ring over the peripheral cornea, limbal area and adjoining conjunctiva and is greatest in the inferior cornea. This forms a so-called ‘doughnut’ pattern as shown in Figure 2.

Confusingly for practitioners the age-old maxim of ‘if it ain’t broke, don’t fix it’ seems not to apply with reports confirming the author’s personal experience, that the signs and symptoms of solution intolerance may occur with continued use of a previously successful MPS when refitting from hydrogel to silicone hydrogel materials.

Staining grid

Out of a desire to help practitioners more quickly and easily identify the potential for staining, Andrasko developed a testing and evaluation protocol for a variety of lens and solution combinations. The results of his work are then placed on a grid and colour coded to give the clinician an arbitrary traffic light scale of green (safest), yellow and red (high risk). This scale and the grid are not without detractors, leading to researchers and industry representatives presenting conflicting data and opinions about staining levels and their significance to ocular surface health.

IER Matrix Study

The Institute for Eye Research (IER – now the Brien Holden Institute) Matrix Study has reported on solution-induced corneal staining (SICS). IER defined it as punctate fluorescein staining associated with the lens care regimen and affecting at least four of five areas of the cornea, presenting as either diffuse (spread over the cornea) or as a peripheral/annular band around the limbus, depending, to a greater or lesser extent, on the care solution/silicone hydrogel combination used.

Differences between the IER Matrix and staining grid

The difficulty in comparing information from the IER Matrix Study and the Andrasko Staining Grid is that the Andrasko grid reports a mean area of the cornea affected after two hours’ exposure to a brand new lens soaked overnight, while the IER data presents the incidence from a clinical study over three months (Table 1).

The staining grid has been proposed as a predictor of clinical performance. The main problem with this approach is that there is no evidence to support that the two-hour result correlates with anything that happens with longer-term wear. Unfortunately direct statistical comparisons were not initially possible with the two data sets because the staining grid estimates

TABLE 1

<table>
<thead>
<tr>
<th>Differences between the Andrasko Staining Grid and IER Matrix Study</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Andrasko Staining Grid</strong></td>
</tr>
<tr>
<td>--------------------------------</td>
</tr>
<tr>
<td>Number of patients per combination</td>
</tr>
<tr>
<td>Duration</td>
</tr>
<tr>
<td>Method</td>
</tr>
<tr>
<td>Assessment</td>
</tr>
<tr>
<td>Scale and colouring of grid</td>
</tr>
<tr>
<td>--------------------------------</td>
</tr>
<tr>
<td>&lt;10%</td>
</tr>
<tr>
<td>10-20%</td>
</tr>
<tr>
<td>&gt;20%</td>
</tr>
</tbody>
</table>

TABLE 2

<table>
<thead>
<tr>
<th>IER Matrix Study versus Andrasko Staining Grid for percentage of patients affected</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Lens/solution</strong></td>
</tr>
<tr>
<td>-------------------</td>
</tr>
<tr>
<td>Acuvue Advance</td>
</tr>
<tr>
<td>Acuvue Oasys</td>
</tr>
<tr>
<td>O2Optix</td>
</tr>
<tr>
<td>PureVision</td>
</tr>
<tr>
<td>Night &amp; Day</td>
</tr>
</tbody>
</table>

Colours indicate 50 per cent confidence interval analysis applied to each study with the lowest green, middle two quartiles yellow and highest orange.
the area of staining after two hours of wear and the IER Matrix reports percentages of patients who develop SICS. The percentage area of corneal staining results from the staining grid should be interpreted with caution, however, as they underestimate the more widespread influence some lens/solution combinations have. The IER analysis indicates that presenting the results, as the percentage of patients affected, is a more appropriate method. Latterly, however, you can obtain the percentages of patients affected in the Andrasko studies by clicking on each cell in the grid on the staining grid website. The data now enables some level of direct comparison between the two studies and this can be seen in Table 2.

Additionally the staining grid does not identify potentially problematic lens/solution combinations in the ‘real’ (clinical) world. Solutions that have compounded and worsening effects over time can appear relatively benign with the Andrasko two-hour assessment compared with longer term wear. For example, longer term wear with the Opti-Free solutions shows relatively poorer performance with Acuvue Oasys, Air (O2) Optix and PureVision lenses compared with two hours of wear.

‘Rub and rinse’ still necessary
During the last decade there was a marked growth in the use of ‘no-rub’ care regimens. This idea primarily came about because it was well recognised that patients were generally non-compliant with instructions relating to the rub-and-rinse step, with many merely removing the lens from their eye and dropping it into their care regimen overnight. These no-rub products were developed to work optimally on the large amount of loosely bound, non-denatured protein that is found on many conventional lens materials. However, silicone hydrogels deposit small amounts of heavily denatured proteins and increased amounts of lipid, compared to conventional polyHEMA-based materials and there is growing evidence to suggest that patients using silicone hydrogels should continue rubbing their lenses with their care regimen if they are to maintain optimal performance.

The effect of lens wettability and deposition on the surface adsorption of solution components is potentially important to the development of SICS. A recent analysis of the IER Matrix data showed that patients who had experienced SICS had poorer lens surface characteristics at dispensing and at the time of the SICS event compared to patients who had not shown signs of this type of corneal interaction. The cumulative effect of solution use as well as the interaction with deposits, lens surface wetting and lens case interactions should not be overlooked when assessing a SICS response.

Discussion
There is clearly a need for further investigation into the mechanism of SICS. In the meantime, clinicians should question whether two-hour percentage area studies reliably predict the long-term SICS responses for the majority of lens and solution combinations evaluated. The author believes that the IER Matrix data is more clinically relevant as it represents a truer, longer-term indication of the ‘real world’ clinical situation.

Solution sensitivity associated with soft contact lenses is an age-old problem that the development of SiH lenses has simply made more complex. It is certainly the view of the author that what likely started out as a genuine desire to provide
clarity to a situation many practitioners find confusing, the staining grid actually over simplifies the matter and does more harm than good. Certainly the use of either green (suggesting safety) or red (suggesting danger) colouring, is less than helpful in assisting clinician understanding of the complexity of staining. Staining is caused by many factors other than solution toxicity and the pattern, position and density must all be considered in order to diagnose the most likely cause of the staining, as well as its clinical significance and whether any intervention is required. That said, while minimal corneal staining often occurs in contact lens wear, moderate amounts of controllable staining should always be avoided, especially given the links that have been established between SICS and low-grade corneal inflammation and discomfort. At the same time there is increasing evidence that the latest generation of MPS formulations produce lower levels of SICS.

It is important for practitioners to remember the fundamental function of lens care – that of cleaning and disinfection. In recent years some manufacturers have turned their attention to other attributes such as improving the lens hydration characteristic and comfort. Practitioners must reflect on the core requirements of a contact lens solution before basing their recommendation on slick marketing of the ‘nice to have’ attributes rather than the ‘need to have’ performance and compatibility.

As the author has previously written, all solution manufacturers should adopt a new acronym for KISS, the popular corporate maxim – Keep Ingredients in Solutions Simple. To their credit in recent years some manufacturers have refocused their R&D on the primary objectives for a cleaning and disinfecting product, abandoned the ‘no-rub’ idea and kept the addition of other non-essential ingredients, that might compromise cleaning and disinfecting efficacy, to a minimum.

**Conclusion**

A delicate balance exists between the contact lens and its care system and the health of the ocular surface in contact lens wear. Many practitioners need to reconsider the priority they place on lens care selection. A number of criteria must be considered when selecting a solution to ‘prescribe’ for an individual patient and the principal ones are:

- Detailed patient history
- Lens material to be/being worn
- Patient compliance potential.

Any lens/solution interaction is not predictable according to preservative type and concentration alone. It is critical, therefore, to keep up to date with how all the latest contact lens solution products interact with all of the current silicone hydrogel materials by constantly reviewing the latest scientifically valid data as to which combinations are the most efficacious and benign. Additionally, understanding the propensity of different SIH materials to deposit lipids, the selection of a solution with good surfactant cleaning ability combined with a clear recommendation (from both bottle instructions and the practitioner) to thoroughly rub and rinse will significantly reduce the incidence and severity of SICS.

Simply put, the considered selection of a lens care product has the potential to significantly improve the comfort and wearing times of many patients. Along with the appropriate selection of contact lens material and modality, this will have an important role to play in the long-term success of individual contact lens patients.

**References**


**Nick Atkins is a contact lens optician and professional affairs/marketing consultant to the optical industry.**